

BROMIDE OF ETHYL

AS AN
ANÆSTHETIC.

BY

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No. I.

BROMIDE OF ETHYL IN DENTAL
SURGERY.

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MR. PRESIDENT AND GENTLEMEN,—In America and on the Continent, and especially in Germany, Bromide of Ethyl has for some time past been held in high repute by dental surgeons. In this country, however, I know of no records of its systematic employment in a similar manner; I was, therefore, very willing to fall in with the suggestion made to me in the summer of 1889, by my friend and colleague Mr. Newland-Pedley, and endeavour to obtain some personal experience of the action of this drug.

In laying before you the record of my observations, I am particularly anxious that it should not be considered that I appear as an advocate for the indiscriminate use of the drug, or that I in any way suggest that we have in bromide of ethyl, an entirely satisfactory substitute for any of the agents usually employed for the purposes of the dental surgeon. In the table of cases appended (Appendix A) I have endeavoured to

record in a strictly impartial manner my own experiences, and in the remarks which I am about to make in elucidation of this table I shall endeavour to be equally impartial, leaving each of you to form your own opinion as to whether the drug is worthy of more extended trial.

History.—The anæsthetic history, so to speak, of bromide of ethyl, is a very curious and instructive one, but hardly comes within the scope of the present paper. In appendix B I have made a list of the most important authorities, and it will therefore suffice if I here mention that bromide of ethyl was first used as an anæsthetic by Nunneley, of Leeds, in 1849; was again brought forward by him in 1865, and some years later its use was advocated by Turnbull and by Levis in America. For its introduction into dental work we are, I fancy, indebted to Schneider, of Berlin, and Herz, of Vienna.

Properties.—It is not my intention to discuss in detail, either the physical and chemical properties or the physiological action of the drug, but in the course of this inquiry one or two points of practical importance have cropped up, to which I feel bound to refer.

In the first place, when you ask for bromide of ethyl (C_2H_5Br .) be sure that your order is understood. By a mistake on the part of a

chemist, bromide of ethylene ($C_2H_4Br_2$) has been substituted, and with fatal results. In the majority of my cases I have used Merck's preparation of the bromide, which is the one almost universally employed in Germany; in some few instances an English sample of the drug was used, but although I am assured by Mr. Martindale, the chemist, that the chemical purity of this latter was quite equal to the German, yet I have not any doubt in my own mind as to the difference in the effects produced, the difference being strongly in favour of Merck's.

It is very probable that this variation in the effects, may be partly or even entirely explained, by the decomposition which the drug apparently undergoes on keeping, especially if exposed to light and air. If you refer to cases 16 to 20 you will see, that when a sponge was used which had been inadvertently left unwashed after the previous series of cases, the results were pre-eminently unsatisfactory.

It is usually asserted that one of the chief reasons which led to the disuse of the drug in 1849 was its cost, and although this is of course a minor point, yet I think I may safely say, that where any number of administrations are undertaken, the cost per patient is very little more than half the cost of nitrous oxide.

Sex and Age.—Coming now to the consideration of the various columns of my table of cases. Both sexes have been dealt with in about the usual proportions, and the ages have varied from nine to forty-nine years. I think, however, that it would appear, that robust and healthy males tolerate the drug better than weakly anaemic females, or than children.

Dose.—Of course the amount necessary to produce anaesthesia varies *inter alia* with the method of administration. Thus, with the open or semi-open method, as in the first seven cases, 70*m* to 3*iii* were required. With the closed method, on the other hand, 3*iss* has usually proved ample, and in many instances 3*i* has sufficed. In making this estimate I have taken into consideration only single cases or first cases of a series, for as you see, in many instances the dose recorded simply represents the amount added to an unknown quantity remaining in the inhaler from the preceding case. But still I think there are a sufficient number of these single and first cases to warrant me in putting the dose down at 3*i* to 3*iss*. I am inclined to emphasize this point, because I fancy that a good deal of misapprehension exists on this score. For instance, the *British Medical Journal** has

recently commented upon a death which followed the use of bromide of ethyl, and says that "not more than twenty grammes" were administered, but as this represents considerably over

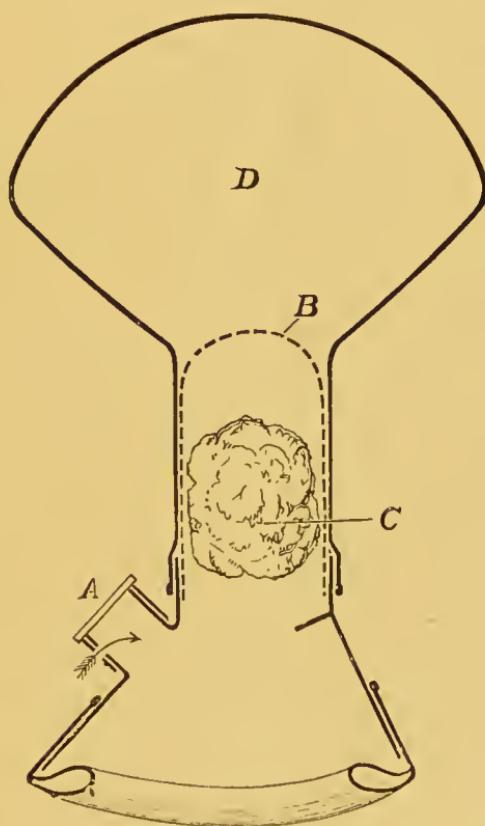


Fig. I.—Sectional view of Ormsby's Inhaler.

A—Air-hole. B—Wire cage, containing sponge C, over which is placed the rubber bag D.

half an ounce, I should myself be inclined to express surprise at the largeness, rather than at the smallness, of the dose.

Method of Administration.—In the first seven administrations either a leather cone, fitting

closely to the face, and open at the apex in which a small piece of absorbent material was placed, or a Skinner's frame-inhaler were used, but neither of these plans quite satisfied me. In August last year I attended the International Medical Congress at Berlin, mainly with the object of obtaining some information upon this subject. I had thus an opportunity of observing the methods in vogue at the Berlin Dental Hospital, and consequently administrations 8 to 94 have been conducted by means of an ordinary Ormsby's inhaler.

In using this inhaler, the drug is poured through the facepiece on to the sponge, and it is then fitted to the face; little or no air is admitted for the first few inhalations, after which the cap of the airhole is slightly turned.

Time limits.—In estimating the time taken to induce anæsthesia, it would obviously be unfair to include all methods of administration together. Taking, therefore, only the closed method, *i.e.*, when the Ormsby's inhaler was used, I find that I have recorded twenty observations, from which I estimate the average time of induction to be 66.8 secs., or slightly less than in the case of nitrous oxide. The duration of the anæsthesia thus produced I found to be 46.2 secs., an average arrived at from the consideration of twenty-eight cases—this is nearly half as long again as with nitrous oxide.

Roughly speaking, the duration of the anæsthesia bears some relation to the time required for induction, but of course this is by no means absolute, and with the English samples of the drug the variability is very marked. It would certainly appear, too, that when the time from the commencement of the inhalation to the end of the anæsthesia exceeds two minutes, the after-effects are very likely to be troublesome.

Phenomena.—The question which I have most frequently had to answer has been: “How do you know when a proper degree of anæsthesia has been produced?” The reply to this is not so simple as might appear. In Berlin some stress seems to be laid upon the muscular relaxation, but I have not found that this is at all reliable. I have myself generally removed the facepiece when the faintest stertor is heard, or if that is obviously due to accidental causes, or if it is unduly delayed, the commencing weakness of the pulse or the development of conjunctival insensibility are my guides. The stertor to which I refer is not the laryngeal stertor of nitrous oxide narcosis, but of a much lighter and regular kind, originating probably in the palate.

During the course of the inhalation, I think it will be found that the breathing becomes very slightly slower and shallower, but in the majority

of cases these changes are almost inappreciable. I have never been able to detect any irregularity in the rhythm, nor, as a general rule, has any cough, laryngeal spasm, or bronchial irritation been set up. In speaking thus of the effects upon the respiration, I would remind you that my remarks apply, only to the special methods adopted in the production of anaesthesia for the purposes of the dental surgeon, and are not in any way applicable to the effects produced when the anaesthesia is prolonged.

There can be no doubt, I should think, that the cardio-vascular or circulatory system is much disturbed during the inhalation of bromide of ethyl. The primary flushing of the face is, I think, a pretty constant phenomenon, though it may be but momentary in its duration; this effect is very similar to that produced by nitrite of amyl, and, I should fancy, may be explained in the same way, *i.e.*, arterial dilatation with consequent fall of blood pressure. This fall in blood pressure may, no doubt, to a certain extent, in itself account for the diminution in force, and increased frequency of the heart beat, as observed at the radial pulse. It is highly probable, however, that other factors are at work, for to the flushing quickly succeeds a pallor, and the heart's action tends to become more feeble, slower and irregular.

I do not myself profess to be a good interpreter of sphygmographic tracings, which may possibly be the reason why I am somewhat sceptical of their value. Others, however, may have more ability, and greater faith in this direction, so I show you (figs. II. to VII.) a few of the many tracings I have taken. In each set the capital letter (A, B, &c.) points to the trace taken immediately before the inhalation commenced, while the small letters (a, b, &c.) point to the trace taken at the height of the anaesthesia, *i.e.*, immediately after the facepiece was removed.

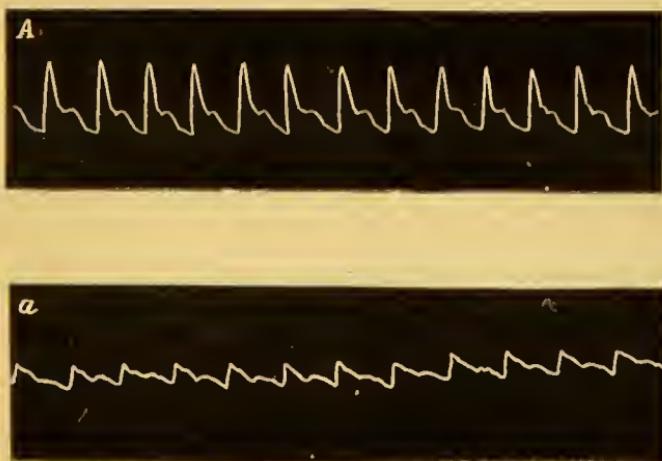


Fig. II.
Case 58, F., æt. 21; dose 5*i.*

I think, on the whole, these tracings bear out the views I have put forward in respect to the effects of the bromide upon the circulatory system, especially if we remember, that the heart's

action immediately before the inhalation is unduly accelerated by the nervous condition of the

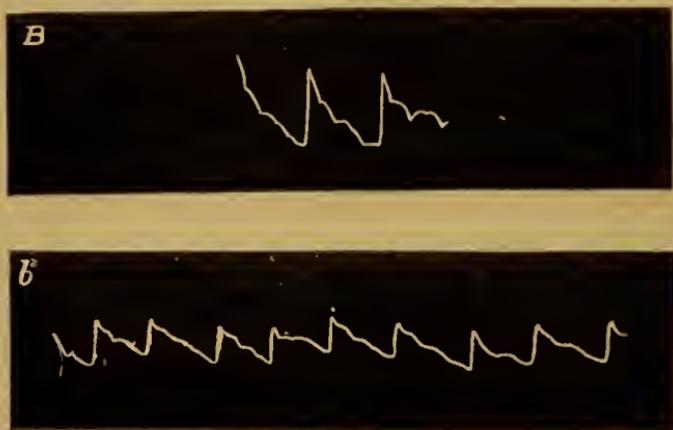


Fig. III.
Case 65, F., æt. 24; dose 5ss.

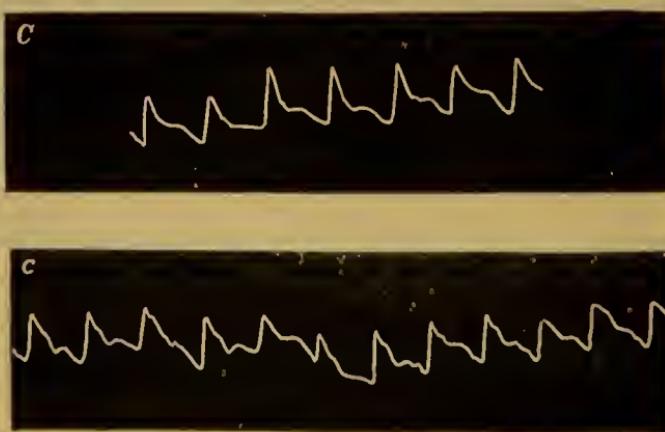


Fig. IV.
Case 66, F., æt. 25; dose 5ss. added to No. 65.

patient. Tracings of the F series (Fig. VII.), I think, are particularly interesting, as indicating (f' taken soon after recovery) the rapidity with

which the blood-pressure, &c., is restored. This rapid recovery is, I believe, usual, and is of great importance.

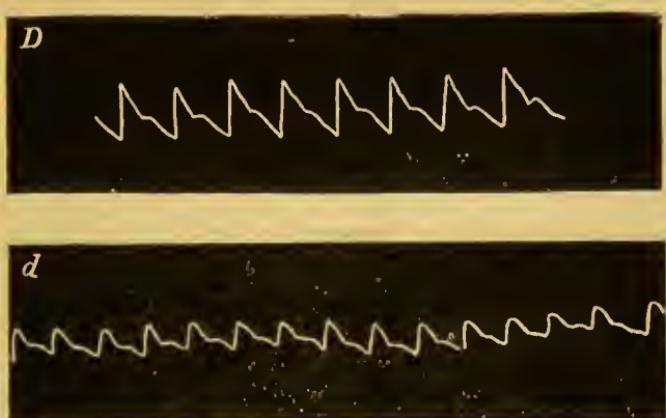


Fig. V.
Case 83, M., æt. 23: dose 5iiss.

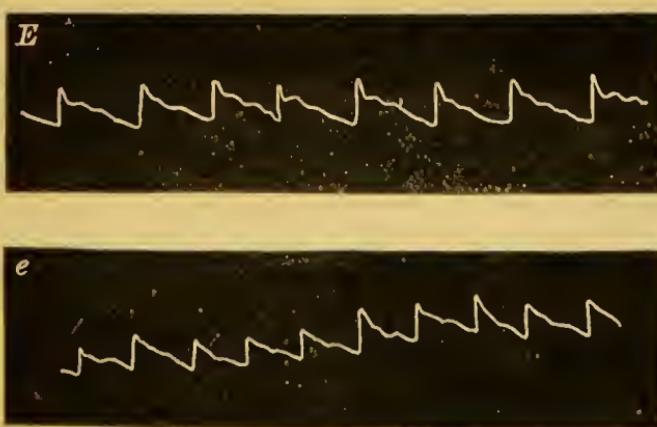


Fig. VI
Case 92, F., æt. 21; dose 5i. added to No. 91.

In respect to the influence of the drug upon the nervous system, and through it upon the muscular system, there is one point with which

I have been particularly struck, *i.e.*, the exceedingly transient character of the stage of excitement. In the majority of cases this stage has been almost inappreciable, and in all but Case 5 quite evanescent. This observation would seem

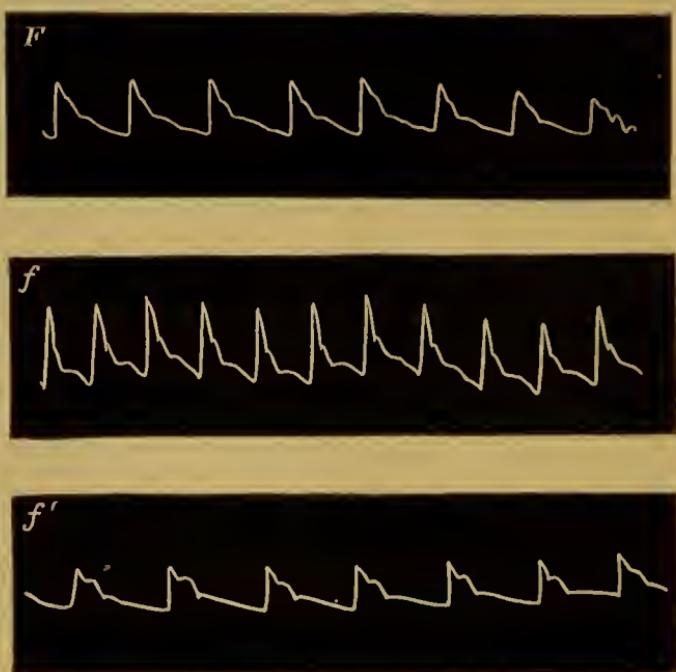


Fig. VII.

Case 94, M., æt. 23 ; dose 5*i.* added to No. 93.

f' Taken ten minutes after recovery.

to apply almost equally to nervous women, and to the robust and probably alcoholic navvy, and it may possibly serve as an indication for the class of cases, in which the use of the drug is more particularly appropriate. Occasionally we get a very slight spasm of the fingers, or rhythmic move-

ments of the limbs, &c., but I have never observed anything like the degree of spasm and movement which often accompanies nitrous oxide and ether.

In respect to other phenomena I have not much to say. The pupils tend to dilate. Increase in the salivary secretions was sufficiently marked to attract attention in Cases 21, 26, 28, and 29, but I have never seen it so copious as with ether. In some few instances the patients will make a groaning noise from the beginning of the inhalation, but this I have always ignored, and have not found that it either delayed or shortened the narcosis.

The anæsthesia which has resulted from the use of the drug has, to my mind, always been quite satisfactory, both in degree and kind, but on this point I hope we may have the testimony of those who have operated in some of the cases recorded.

After Effects.—The after-effects of an anæsthetic are of very great importance, not only to the patient, but also to the dental surgeon. They may be divided into those observable immediately after the return to consciousness, and those developed at a more remote period.

In respect to immediate effects of bromide of ethyl, I have definite notes in thirty-nine instances. In eleven a certain amount of hysteria resulted; in ten others, more or less depression

or prostration occurred. In one instance (No. 69) actual fainting ensued, but this was in a patient subject to what she termed "fainting fits." Actual sickness was noted in two cases (Nos. 1 and 19), and in seven others nausea was complained of. Slight and transient degrees of exhilaration were developed in three instances (Nos. 74, 83, and 91), and in many of the cases a certain amount of confusion of intellect has remained for some few minutes. Strictly speaking, of course, all these figures refer only to the thirty-nine cases noted; but in respect to the fainting and vomiting, I think that the numbers may very fairly be held to be applicable to the whole series, as it is extremely unlikely that such effects, if they had occurred, would have remained unrecorded.

By making use of post cards printed with my address, I have been enabled to obtain a rough estimate of the remote effects of the bromide in 45 instances. Of this 45, in no less than 29 the return was to the effect that the patients were perfectly well on their return home, and for the remainder of the day. Of the remaining 16, prostration or depression is noted in 5 instances, vomiting in 2, and headache in 3. In Case 55 the return was, "ill all day," but I was not able to ascertain of what this illness consisted; possibly it may have been simple hysteria. Of the

remaining 5, dizziness, drowsiness, and other very trivial and doubtful complaints are recorded.

But there is another aspect of this question, viz., the relation between immediate and remote effects. In 17 cases observations of both appear in the table, and from these we gather, as might be expected, that the importance and severity of the remote symptoms is tolerably proportionate to the immediate after-effects. Thus, simple hysteria has seldom been followed by anything worse, while, on the other hand, nausea may be followed by sickness, or the sickness may be prolonged. This somewhat negative evidence is of importance, for it enables me to say that, so far as my own limited experience is concerned, I have never met with a case in which serious symptoms have developed upwards of twelve hours after the bromide has been inhaled. Such cases have, however, been described.

Death-rate.—In preparing this paper, I have been very strongly tempted to refer to the dangers and the death-rate of bromide of ethyl, but on the whole I prefer to adhere to my original plan, and limit my remarks strictly to the facts that have come under my own cognisance, as exemplified in the record of cases. I am well aware of the importance of this point, however, though I cannot help thinking, that the fatalities which have been hitherto recorded, rather tend to exaggerate the

dangers of the drug when used in dental surgery and in the way I have to-night described.

Conclusion.—Such, gentlemen, is my experience of the use of bromide of ethyl as an anaesthetic in dental surgery. In many points this experience is favourable, in many others adverse; so that, taking into consideration the relatively small number of cases which I have recorded, it will not be expected of me to express dogmatic opinions upon the value of this potent drug. Before sitting down, however, I must apologise for the length of my paper, and at the same time I should like publicly to express my indebtedness to Mr. Maggs and Mr. Mansbridge, and my other colleagues of the Guy's Hospital Dental School, for the permission they have so readily given me to use their cases for the purposes of this investigation. Without this help, and that of the senior students of the school, I could have accomplished nothing, and even now I feel that the result has been far less satisfactory than I could have wished.

APPENDIX A.

TABLE OF CASES.

APPENDIX A.

No.	Sex. Age.	Quantity.	Method.	Time.		PHENOMENA.		
				Induc- tion.	Anæs- thesia.	Respiration.	Circulation.	
1	F 20	3ii. in two separate doses.	Long leather cone, open at apex, with lint inserted.	...	...	Fair; no cough, slight palatine stertor.	Flushing of face, followed by pallor.	
2	F 19	3ii. in two separate doses.	Leather cone, open at apex, with lint in- serted.	125 secs.	...	Fair; no cough, no stertor.	Flushing of face, less marked than in No. 1, pulse be- came irregular.	
3	F 17	3iii. in suc- cessive doses of 3i.	Corner of towel.	5 m.	...	Fair; slight laryn- geal spasm, no stertor.	Flushing of face; pulse in- termittent, subsequently full and bounding.	
4	F 18	3ii. mx.	Guttatim on Skinner's eage.	...	...	Fair; becoming slow, slight in- termittent stertor towards end.	Flushing followed by pallor of face; pulse intermittent then after face-piece re- moved, becoming full and bounding.	
5	F 27	70 ml.	As Case 4.	...	...	Restrained.	Pulse gradually failing, sub- sequent re-action as in Case 3.	
6	F 36	3ss.	As Case 4.	...	...	Fair, becoming shallow.	Pulse good during inhala- tion, feeble after.	
7	F 28	3iss.	As Case 4.	3½ m.	...	Same as Case 6.	Pulse failing, and decidedly feeble after face-piece re- moved.	
8	F 18	3ii.	Ormsby's in- haler— no air for first 5 or 6 in- halations, then a little	...	...	Fair, no stertor.	Primary flushing of face pulse fair but failing, de- cidedly feeble just after.	
9	F 12	3i. added to above.	As Case 8.	...	...	Shallow, slight stertor.	...	Same as No. 8.
10	F 22	3i. added to No. 9.	As Case 8.	...	...	... Fair. ...	...	Same as No. 8.
11	F 40	3i. added to No. 10.	As Case 8.	...	...	Same as No. 10.	...	Same as No. 8.
12	F 29	3ss. added to No. 11.	As Case 8.	...	...	Same as No. 10.	...	...
13	F 27	3i. added to No. 12.	As Case 8.	...	...	Same as No. 10.	...	Same as No. 8.
14	F 33	3i. added to No. 13.	As Case 8.	...	...	Groaning from be- ginning, not ceas- ing during height of anaesthesia.	...	...
15	F 26	3iss.	As Case 8.	...	...	Fair; groaning all time.	...	Primary flushing.
16	F 22	3i. added to No. 15.	As Case 8.	50 sees.	50 sees.	...	...	Pulse became very small.
17	F 33	3i. added to No. 16.	As Case 8.	70 sees.	40 sees.	Groaning all time.	...	...
18	F 24	3i. added to No. 17.	As Case 8.	75 sees.	65 sees.	... Stertor. ...	...	...
19	F 31	3i. added to No. 18.	As Case 8.	95 sees.	55 sees.	Restrained.	...	Slight lividity.
20	F 24	3i. added to No. 19.	As Case 8.	45 sees.	...	... Fair. ...	...	...
21	F 20	3iss.	As Case 8.	50 sees.	45 sees.	...	...	Pulse became weaker; ver- free flow of saliva.
22	F 46	3i. added to No. 21.	As Case 8.	65 sees.	50 sees.	Regular stertor.	...	...

TABLE OF CASES.

		After-Effects.			Remarks.
Muscular and Nervous.		Immediate.	Remote.		
Complete relaxation. No excitement, pupils slightly dilated, conjunctivæ injected, but not absolutely insensitive until after face-piece removed.		Tendency to syncope ; prostration ; sick.	Sickness continued for some little time.		
Complete relaxation. Hysterical laughing during inhalation, otherwise as in No. 1.		...	...	...	Anæmic girl.
Complete relaxation. Conjunctivæ injected and not insensitive, pupils dilated.		Retching.	Prostration.		Anæmic girl.
Complete relaxation. Very transient excitement, pupils slightly dilated, conjunctivæ insensitive.		Tendency to syncope and nausea.	Nausea.		Had just taken alcohol.
Marked and uncontrollable excitement.		Syncope.	...	...	Very nervous woman.
...	...	Prostration.	...	...	Duly pushed to relaxation, said she felt extraction.
...	...	Nausea and prostration.			
No subsultus. Pupils unaffected, conjunctivæ not insensible until just after face-piece removed.		Transient depression.	Nil.		
Slight spasm. Pupils dilated.		Same as No. 8.	Looking pale, but feeling well.		
...	...	Same as No. 8.	Nil.		
Conjunctivæ not insensitive until after face-piece removed, pupils unaffected.		Same as No. 8.	Nil.		
...	...	Same as No. 8.	Slightly dizzy.		
...	...	Same as No. 8.	...	...	Hysterical—said to have had "brain fever."
Slight spasm. Pupils dilated.		Hysteria.	Slight headache.		Some time coming round.
Flaccidity.	...	...	...	...	Anæsthesia imperfect.
Screaming after removal of face-piece.		...	...	...	Anæmic. Unwashed sponge used.
...	...	Hysteria.	Nil.		Anæmic. Unwashed sponge.
Pupils dilated.	...	Nausea.	Nil.		Unwashed sponge.
...	...	Sick.	Vomiting.		
Screaming after removal of face-piece.		...	...	...	Unwashed sponge.
Pupils dilated.	...	...	...	...
Pupils, if anything, smaller.		Dazed ; nausea.	Languid.		
			Nil.		

No.	Sex. Age.	Quantity.	Method.	Time.		PHENOMENA.				
				Induc- tion.	Anaes- thesia.	Respiration.			Circulation.	
23	F 20	3i. added to No. 22.	As Case 8.	45 secs.	27 sees.	...	...	...	...	...
24	F 22	3i. added to No. 23.	As Case 8.	60 secs.	50 sees.	Stertor commen- cing.	...	...	...	...
25	F 38	3i. added to No. 24.	As Case 8.	...	...	Groaning all time.	...	Pulse became small.	...	...
26	F 20	3i. added to No. 25.	As Case 8.	65 secs.	60 sees.	Stertor (saliva).	...	Free flow of saliva.	...	...
27	F 22	3i.	As Case 8.	...	...	Fair.	...	...	...	...
28	F 24	3ss. added to No. 27.	As Case 8.	80 secs.	40 sees.	Fair.	...	Free flow of saliva.	...	...
29	F 40	3ss. added to No. 28.	As Case 8.	70 secs.	75 sees.	Fair; very slight stertor.	...	Free flow of saliva.	...	...
30	F 9	3ss. added to No. 29.	As Case 8.	40 secs.	40 sees.	Restrained, slight stertor.	...	...	...	...
31	F 17	3ss. added to No. 30.	As Case 8.	40 secs.	55 secs.	Slight stertor.	Pulse beginning to fail.			
32	F 18	3ss. added to No. 31.	As Case 8.	68 secs.	55 secs.	...	...	...	...	...
33	F 22	3i.	As Case 8.	...	...	Slight stertor.	...	...	...	...
34	M 14	3ss. added to No. 33.	As Case 8.	...	...	Slight stertor.	Pulse commenced to intermit.			
35	F 32	3ss. added to No. 34.	As Case 8.	...	...	Slight stertor.	Pulse became weaker, but regular.			
36	F 13	3ss. added to No. 35.	As Case 8.	...	...	Stertor very early; slightly irregular at end.	Pulse commenced to intermit.			
37	F 16	3ss. added to No. 36.	As Case 8.	...	...	...	...	Pulse unaffected.	...	...
38	F 25	3i.	As Case 8.	...	...	Fair; slight stertor.	...	Pulse failing.	...	...
39	F 22	3ss. added to No. 38.	As Case 8.	...	...	Same as No. 38.	...	Same as No. 38.	...	...
40	F 18	3ss. added to No. 39.	As Case 8.	...	...	Same as No. 38.	...	Same as No. 38.	...	...
41	M 15	3ss. added to No. 40.	As Case 8.	...	...	Regular and deep.	...	...	...	...
42	M 17	3ss. added to No. 41.	As Case 8.	...	...	Fair; stertor.	...	...	...	...
43	M 15	3ss. added to No. 42.	As Case 8.	...	...	Same as No. 42.	Pulse slowed, force increased.			
44	F 21	3i. Ormsby, a little air from first.	As Case 44.	...	...	Same as No. 42.	...	...	...	...
45	F 19	3i. added to No. 44.	As Case 44.	...	...	...	...	...	...	...
46	F 24	3ss. added to No. 45.	As Case 44.	...	...	...	...	...	...	...
47	F 30	3ss. added to No. 46.	As Case 8.	...	67 secs.	Groaning all time.	...	...	...	...
48	F 17	3i. English drug.	As Case 8.	...	...	...	...	Pulse failing.	...	...
49	F 19	3ss. added to No. 48.	As Case 48.	...	30 sees.	Faint stertor.	Pulse failing.			
50	F 19	3ss. added to No. 49.	As Case 48.	...	...	Slight stertor.	Pulse failing.			

TABLE OF CASES.

Muscular and Nervous.	After-Effects.			Remarks.
	Immediate.	Remote.		
...	Same as No. 22.	...	...	Stunted and anaemic, double cataract.
...	...	Nil.		Anæmic. Same patient as No. 16.
Pupils, if anything, smaller.	Feeling faint.	Nil.		
Considerable excitement at first, tendency to opisthotonus.		Nil.		Same patient as Nos. 16 and 24.
...	...	Very heavy and drowsy.		
...	...	...		Same patient as No. 11. Recovery very slow.
Some struggling, tendency to opisthotonus. Screaming directly facepiece removed.	...	...	...	Unsatisfactory.
Slight struggling. Screaming directly face-piece removed.	...	...	Slight headache.	
Irregular movements of legs.	...	...	Nil.	
Pupils unaffected.	...	...
Slight spasm of fingers, twitching and spasm of flexors of wrist. Pupils not dilated.				
Pupils unaffected.	...	...	Nil.	
Pupils slightly dilated, excitement with shouting after face-piece removed.	...	...	Nil.	
...	Hysteria.	...	...	Poorly nourished, took a good deal, recovery slow and bad.
Pupils unaffected.	...	...	Nil.	
Same as No. 38.	...	...	Nil.	
Same as No. 38.	...	...	Nil.	
Spastic movements of hands and feet, slight spasm when tooth seized. Pupils slightly dilated.	...	...	Nil.	
Same as No. 41, but slighter.	...	...	Nil.	Very sick day following (haemorrhage).
Pupils slightly dilated.	...			
Light struggling.	...	...	Feeling of weakness.	
...	Hysteria.			
...	...	...	Nil.	
Pupils dilated after facepiece removed.	...	...	Nil.	
Pupils not dilated, screaming.	...	...	Nil.	Probably felt.
Screaming.	...	...	Nil.	Did not feel.
Screaming.	...	...	...	Stout girl.

APPENDIX A.

N ^o .	Sex. Age.	Quantity.	Method.	Time.		PHENOMENA.					
				Induc- tion.	Anes- sthesia.	Respiration.			Circulation.		
51	F 39	5ss. added to No. 5.	As Case 48.	...	35 secs.	Slight stertor, groaning all time.	Pulse failing.	...	...	...	...
52	F 32	5ss. added to No. 51.	As Case 48.	...	40 secs.	Groaning and mut- tering after first few inspirations.	...	...	...	...	...
53	F 24	5ss. added to No. 52.	As Case 48.	85 secs.	30 secs.	Slight stertor, groaning and muttering all time.	...	...	...	...	...
54	F 20	5ss. added to No. 53.	As Case 48.	...	40 secs.	...	...	...	...	...	...
55	F 26	5ss. added to No. 54.	As Case 48.	55 secs.	30 secs.	...	...	...	...	...	...
56	M 15	5ss. added to No. 55.	As Case 48.	85 secs.	20 secs.	...	...	...	...	...	...
57	M 11	5ss. added to No. 56.	As Case 48.	80 secs.	25 secs.	Slight stertor.	...	...	...	...	...
58	F 21	5i.	As Case 8, Merck's drug.	...	...	...	Fair.	...	...	...	...
59	F 20	5ss. added to No. 58.	As Case 8, English drug.	...	...	...	Fair.	...	...	...	...
60	F 21	5ss. added to No. 59.	As Case 59.	...	...	...	...	...	...	...	...
61	F 12	5ss. added to No. 60.	Ormsby, much air, English drug.	...	...	...	Fair.	...	...	...	...
62	F 20	5ss. added to No. 61.	As Case 8, Merck's drug.	...	...	...	...	...	...	...	...
63	F 19	5i.	As Case 62.	...	...	Fair, slight stertor.	...	...	...	...	...
64	F 43	5ss. added to No. 63.	Ormsby, no air. Merck's drug.	...	...	Shallow.	...	...	...	...	...
65	F 24	5iss.	As Case 64.	...	...	...	...	...	...	...	...
66	F 25	5ss. added to No. 65.	As Case 64.	...	...	...	...	...	...	...	...
67	F 33	5ss. added to No. 66.	As Case 64.	...	...	...	...	...	...	...	...
68	F 22	5ss. added to No. 67.	As Case 64.	...	...	...	...	...	...	...	...
69	F 24	5iss.	As Case 64.	...	...	Fair; decided ster- tor.	...	...	...	...	...
70	F 34	5ss. added to No. 69.	As Case 64.	...	...	Fair; stertor.	...	...	...	...	...
71	F 31	5ss. added to No. 70.	As Case 64.	...	...	Stertor.	...	...	...	...	...
72	F 23	5ss. added to No. 71.	As Case 64.	...	...	Stertor.	...	...	...	...	...
73	F 22	5ss. added to No. 72.	As Case 64.	...	...	Stertor.	...	Primary flushing, pulse slowed and improved it	...	...	...

TABLE OF CASES.

Muscular and Nervous.	After-Effects.						Remarks.
	Immediate.			Remote.			
...
...	Sleepy and languid.		
Slight excitement.	Hysteria.		Nil.		
Movements of hands and arms directly tooth seized.	Very ill.	Did not feel.	
Brief excitement.		
Pupils not dilated.		[II., p. 128.]
...		Pulse tracing taken: Fig.
...		<i>A</i>) Immediately before inhalation.
...		<i>a</i>) At height of anaesthesia.
...	Same patient as 54.	
...	Hysteria.	...	...
...	Screaming and Hysterical.	...	Prostration and Headache.		
Screaming.	Did not feel. Props slipped.	
...	Nil.		
...	Same patient as 49.	
Pupils not dilated.	Nil.		
...		Some time coming round.
...		Pulse tracing taken: Fig.
...		III., p. 129.]
...		<i>B</i>) Immediately before inhalation.
...		<i>b</i>) At height of anaesthesia.
...		Took badly. Pulse tracing taken: Fig. IV., p. 129.]
...		<i>C</i>) Immediately before inhalation.
...		<i>c</i>) At height of anaesthesia.
Slight spasm. Pupils not dilated.	Pain in neck.		
...	Nil.		
Some spasm towards end. Pupils unaffected.	Hysteria. Fainted.	...	Very weak.		Tall anaemic girl, subject to fainting attacks.
...	Dazed.		
...	Hysteria.	...	Nil.		
...	Nil.		
...		Typical.

APPENDIX A.

N ^o	Sex. Age.	Quantity.	Method.	Time.			PHENOMENA.				
				Induc- tion.	Anaes- thesia.	Respira- tion.	Circulation.				
74	F 19	5ss. added to No. 73.	As Case 64.	...	...	... ... ...	...	...	...	...	...
75	F 28	5iss.	As Case 64.	...	...	Fair; slight stertor.	Flushing of face.	...	...	...	...
76	M 49	5iss.	As Case 64.	...	...	Slight stertor.	Temporal pulse became ir- regular and weaker.	...	...	...	...
77	M 38	5iss.	As Case 64.	...	...	Fair; then shallow, then deeper. Ster- tor.	Pulse became irregular.	...	...	...	...
78	M 38	5iss.	As Case 64.	...	...	Groaning all time.	...	...	...	...	...
79	M 24	5iss.	As Case 64.	...	...	Fair; stertor. ...	Pulse slowed, quite regu- lar, tone improved.	...	...	...	...
80	M 43	5iss. .	As Case 64.	...	...	Restrained, irregu- lar; marked ster- tor.	Pulse slowed and s'ghtly softer.	...	...	...	...
81	M 19	5iss.	As Case 64.	...	50 secs.	Fair; stertor early.	Pulse good all time.	...	...	...	...
82	M 22	5iss.	As Case 64.	...	...	Fair, then quick- ened.	Pulse quietened.	...	...	...	...
83	M 23	5iss.	As Case 64.	...	...	Fair; slight stertor.	...	...	...	...	...
84	F 24	5i added to No. 83.	As Case 64.	...	...	...	...	...	...	...	...
85	M 32	5iss.	As Case 64.	...	...	Fair; slowed, ster- tor.	Primary flushing, followed by pallor, pulse slowed, tone improved.	...	...	...	...
86	M 22	5i.	As Case 64.	...	...	At first rapid, then slowed; slight stertor.	Pulse slowed, quality re- tained, pallor after face- piece removed.	...	...	...	...
87	F 30	5i.	As Case 64.	...	...	Fair; no stertor.	Pulse very variable.	...	...	...	...
88	F 36	5iss.	As Case 64.	...	60 secs.	... Fair.	...	...	...	...	...
89	F 22	5i added to No. 88.	As Case 64.	...	55 sees.	... Fair.	...	...	...	...	...
90	F 19	5iss. Ormsby, a very little air towards end.	As Case 90.	...	...	... Fair.	...	...	...	...	...
91	M 27	5i added to No. 90.	As Case 90.	...	...	... Fair.	...	...	...	...	...
92	F 21	5i added to No. 91.	As Case 90.	...	...	... Fair.	...	...	...	...	...
93	F 21	5iss.	As Case 90.	105 secs.	55 secs.	Fair; slight snor- ing, stertor.	Pulse became irregular, then slowed and improved in tone.	...	...	...	...
94	M 23	5i added to No. 93.	As Case 90.	...	50 secs.	Fair; slight snor- ing.	...	...	...	...	...

TABLE OF CASES.

Muscular and Nervous.	After-Effects.			Remarks.
	Immediate.	Remote.		
...	Excitement.			
Pupils dilated.				
...	Dazed.	...	...	'Bus driver (?) alcoholic.
Slight spasm of extensors of fingers.	...	Nil.		Labourer.
Slight spasm of fingers.	...	...	...	Same patient as No. 77.
Pupils unaffected.	...	...	...	Labourer.
Very slight struggles. Pupils not affected.	Dazed.	...	...	Artisau, tall and neurotic, long recovery.
Slight spasm after face-piece removed. Pupils slightly dilated.	Dazed.	...	...	Labourer, slow recovery.
...	Dazed.	...	...	Labourer.
Rhythmic movements of feet.	Excited.	...	...	Pulse tracing taken : Fig. V., p. 130. D } Immediately before inhalation. d } At height of anaesthesia.
Twitching of hands and legs, flaccidity. Very slight excitement.	...	...	...	Railway clerk, neurotic.
Conjunctivæ very slightly congested, pupils slightly dilated.	Dazed.	...	...	Robust man.
Rhythmic movements of hands after first few inspirations, moved arms during extraction. Conjunctivæ insensible, pupils very slightly dilated.				
Conjunctivæ insensitive.	...	Hysteria.		
Conjunctivæ insensitive.	...	Hysteria.		
Rhythmic movements of fingers. Conjunctivæ not quite insensitive.	Slight excitement.			
...	Nausea.	...	...	Pulse tracing taken : Fig. VI., p. 130. E } Immediately before inhalation. e } At height of anaesthesia.
Pupils dilated after face-piece removed.	Hysteria.			
Pupils not dilated.	...	...	...	A labourer. Pulse tracing taken : Fig. VII., p. 131. F } Immediately before inhalation. f } At height of anaesthesia. f' } After recovery.

APPENDIX B.
BIBLIOGRAPHY.

APPENDIX B.

BIBLIOGRAPHY.

Nunneley's first experiments with bromide of ethyl are related in the course of an account given by him of his elaborate investigations into the properties and action of various anæsthetic agents ; this account was published in the *Transactions of the Provincial Medical and Surgical Association*, 1849, pp. 206 and 325. His second communication on the subject was made to the British Medical Association at their meeting in 1865, and appears in the *British Medical Journal*, 1865, vol. ii., p. 192. For about fifteen years, with the exception of casual and brief annotations, nothing of importance appears to have been written, and the literature of bromide of ethyl may, therefore, be said practically to date from 1880.

The following list comprises the most important communications that have been made on the subject since 1880. I have myself verified the correctness of the references in the majority of instances ; in some few cases, however, (distinguished thus *), this has not been possible, and my information is but second-hand.

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NO. II.

SOME FURTHER OBSERVATIONS ON BROMIDE OF
ETHYL IN DENTAL SURGERY.

(Reprinted from the *Journal of the British Dental Association*,
March 16th, 1891.)

WHILE preparing my paper on Bromide of Ethyl for the Odontological Society, it came to my knowledge that the agenda paper for that particular meeting (February 2nd) was a very full one, and that several communications of far more importance than my own, would have to be made before my paper was read. Believing then, as I do still, that greater interest would attach to the discussion than to the paper itself, I was at some pains to eliminate all facts which had not come under my own observation, and as far as possible to avoid all expressions of personal opinion. Now that the *Transactions* of the Society are in the hands of the members—most of whom are, I believe, also members of the British Dental Association—it may not be out of place if I again refer to the subject.

In the discussion which followed the reading of my paper, great stress was laid upon the number of deaths which had occurred from the use of the drug, but I believe that a good deal of misapprehension exists upon this score, and that, as a matter of fact, a critical examination of the actual deaths alone, by no means justifies the exaggerated views generally held as to the extreme danger attendant upon its employment.

It is usually said that deaths have been reported by the following observers, viz.:—Levis, Sims, Wolff, Lee, Pancoast, and Mittenzweigs; to these must be added one which occurred in Berlin last year, and to which reference is made in the *British Medical Journal* (1890, vol. i., p. 717) and elsewhere. No deaths in England from the use of the drug are recorded.

At first sight this list is somewhat appalling, but as a matter of fact it represents, at the outside, some eight separate cases, in some of

which, too, it is doubtful whether the fatality was actually due to the use of the bromide, and in others the death was, to say the least, accelerated by faulty administration, the use of an impure sample of the drug, &c. But even assuming that eight, or even ten, cases represents the actual death record, is it after all in excess of that ascribed to chloroform within the first few years of the introduction of the latter? I find, for instance, that in the year 1848 alone, no less than ten deaths are ascribed to the use of chloroform. It must be remembered, too, that in the first place these eight deaths were spread over a number of years, and further, that in all probability the proportion of deaths to administrations was even less than with chloroform. On the other hand, the evidence obtained from the action of anaesthetics upon animals, and the inferences to be drawn from such experiments, are not, to my mind at any rate, altogether conclusive of the effects upon human beings. If such conclusions were in every case to be looked upon as final, who would ever dream of using chloroform nowadays? Would not even nitrous oxide itself have died a natural death, after the observations of Hermann, Krishaber, Jolyet and Blanche, &c.?

I have dwelt at some length upon the reputed dangers because I have been complimented in more than one quarter for my boldness and temerity in making a trial of this substance. I cannot pretend to more than the usual amount of courage, but at the same time I would wish to be absolved from any approach to foolhardiness. In my recorded cases will, I think, be found sufficient evidence to enable those who wish to do so, to decide for themselves upon the particular value to be placed upon bromide of ethyl in dental surgery; reference to the death-rate for this purpose I think is quite superfluous or even misleading.

Of those that spoke in condemnation of this drug, but few appear to have had any personal experience of its use, and as I said in my paper, nothing like an extensive trial has been given to it in England. My own deductions from the study of my cases may possibly assist those who have neither the time nor the inclination to try the drug for themselves.

1. If bromide of ethyl is used, the pure drug alone should be employed—by preference that of Merck's manufacture—and in any event the sample must not be taken from a specimen that has been long kept, or exposed to light and air.

2. Rapid induction is essential if we would minimise unpleasant after-effects. A dose of 3iss. poured into an Ormsby's inhaler, and nearly as much care taken to exclude air as if nitrous oxide were being used, will usually effect narcosis speedily.

3. The face-piece may be removed and the operation commenced on the onset of the faintest palatine stertor, or the absolute insensibility of the conjunctivæ.

4. The advantages shown to be possessed by this drug are :—

(a) Its portability and the simplicity of the apparatus required for its administration.

(b) The very slight preliminary excitement.

(c) Prolongation of the primary anaesthesia.

(d) Complete relaxation of the muscles, and absence of spasmodic jerks.

5. Against these, as compared more especially with nitrous oxide, we have to place—

(a) The tendency of the drug to decompose.

(b) Unpleasant after-effects occur much more frequently than with nitrous oxide, and the patients almost always appear more "knocked over."

6. To my mind, these objections alone constitute potent arguments against the routine use of the drug, especially as we have now become so accustomed to the apparatus necessary for the administration of nitrous oxide, and to the jactitations and spasms which follow its use.

7. The absence of the stage of excitement has led me to employ the drug pretty frequently in those cases of the robust navvy type, in whom the administration of ether often gives rise to very great struggling and mental disturbance, and I have always been very pleased with the result.

8. The possibilities of a fatality, although I believe them to be more remote than is usually supposed, should at least teach us that whenever the drug is administered, there is a tendency to syncope; and not only should the operator and administrator never be one and the same individual, but the administration should never be undertaken except by a skilled person, and one qualified and capable to meet any emergencies that are likely to arise.

NO. III.

BROMIDE OF ETHYL AS AN ANÆSTHETIC.

HISTORY AND PROPERTIES.

AT the instance of Mr. F. Newland-Pedley, I have recently conducted a number of administrations of bromide of ethyl in the dental extraction rooms of Guy's Hospital. The records of ninety-four of these administrations were laid before the Odontological Society on February 2nd, 1891, and will be found in the Society's *Proceedings* for that month.

In addition, I have given the drug in thirty-six other instances, making a total of 130 cases.

In consulting authorities; comparing my results with those of other observers, &c.; I came across many facts which interested me greatly. It is just possible that these facts, together with my own experiences, may interest others, and hence this paper.

History.—Bromide of ethyl as an anæsthetic has had a peculiarly chequered career.

In England it was first used by Nunneley of Leeds in 1849, who again spoke in its favour at the British Medical Association in 1865. At the International Medical Congress, held in London in 1881, Dr. Squire read a paper upon its value as a general and local anæsthetic, and Dr. B. W. Richardson concurs in Nunneley's opinion that it is "one of the best of anæsthetics."*

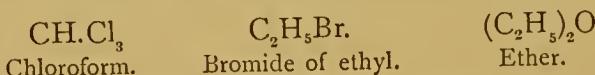
On the other hand, the late Mr. Clover appears to have tried and been dissatisfied with it, and it has never been popular here, nor, as far as I can ascertain, has it ever been used in any very large number of cases. In America the drug was first used by Dr. Turnbull in 1877; Drs. Lewis, Chisholm, Gowers, and others have employed it extensively, and were very energetic in their advocacy of its advantages. In spite, however, of some thou-

* *Asclepiad*, 1885, p. 264.

sands of successful cases, the occurrence of two or three deaths which were attributed to its use, together with the adverse report of Professor Wood on its physiological action* have, I believe practically led to its abandonment in that country.

On the continent, Terillon, Rabuteau, Bourneville and others have experimented with and used it in surgical cases, though without any very encouraging success. During the last few years, however, Schneider of Berlin† Herz of Vienna,‡ and various dental surgeons in Germany, Russia, and other continental countries have recorded many hundred successful administrations, and in fact still appear to be enthusiastic in recommending it.

Chemical and Physical Properties.—In point of chemical constitution its affinities are with ether rather than chloroform, as may be seen on comparing the respective formulæ:—



In respect to physical properties, it resembles chloroform in its high specific gravity, its practically non-inflammable vapour, and the small percentage of the latter necessary to produce narcosis. On the other hand, it is allied to ether chiefly in its low boiling-point, while with regard to its vapour density it occupies a position almost precisely midway between the two.

These points are of considerable importance to the practical anæsthetist, and I have therefore brought them together in the accompanying table:—

	Sp. Gr. at 0° C.	Boiling- point.	Vapour Density.	Percentage of Vapour for Narcosis.
Chloroform . . .	1.525	61 C.	4.20	4
Bromide of Ethyl	1.473	38.37 C.	3.75	8
Ether	0.720	34.9 C.	2.55	30

* *Philadelphia Medical Times*, 1880, p. 370.

† *Deutsche Monatschrift für Zahuheilkunde*, 1888, vol. i. p. 373.

‡ *Internationale Klinische Rundschau*, April 15, 1889.

For the rest it is a colourless mobile liquid with a sweetish and not unpleasant odour, mixing freely with equal volumes of alcohol, chloroform, or ether. It is very prone to decomposition, especially if exposed to air, bromine being set free, and the mixture rendered very irritating or even dangerous. The German makers appear, however, to have succeeded in producing a body of greater stability than the English, and it is Merck's bromide of ethyl that I have mostly used.

The vapour, brought into contact with a flame, evolves whitish fumes having a slightly pungent odour, and giving rise to cough and laryngeal irritation.

Physiological Action.—The blood-pressure is very rapidly lowered and the arteries dilated, but according to some observers (e.g., Squire),* this is not due to or even of necessity associated with failure of heart's action. I am myself, however, inclined to agree with Professor Wood,* who says that it is distinctly a cardiac depressant, though possibly less so than chloroform.

The flow of saliva is generally increased during its administration, and if the inhalation is continued for any length of time, e.g., thirty to forty minutes, gastro-intestinal irritation results, and may be so great as to endanger life.

In other respects it resembles chloroform in its action.

Method of Administration.—Much of the disfavour with which this drug has been viewed, and the unsatisfactory results obtained, have, in my opinion, been due to faulty methods employed in its administration, as my own personal experiences would seem to indicate. Arguing from its analogy to chloroform, I first administered the bromide by the open method, with abundant admixture with air, and was much dissatisfied with the effects ; the semi-open method with partial exclusion of air yielded rather better results, though still unsatisfactory. On my visit to Berlin in 1890, I found that a closed ether-inhaler (Fig. I., p. 7) known to us as an Ormsby's Inhaler, was used by Schneider at the Dental Hospital, and since I have employed this apparatus and Merck's bromide, my results have been much more uniform and much more satisfactory. In fact, I would almost go further, and say, that in the administration of bromide of ethyl, the same care

**International Medical Congress, London, 1881, vol. i. p. 451.*

should be taken to exclude air as is done when nitrous oxide is employed. Used in this way, I have found that between 3*i* and 3*ii* have usually sufficed to produce anæsthesia in, on an average, 66.8 secs., and that the primary narcosis thus obtained has lasted 46.2 secs.

By preference of course the recumbent position should be chosen, but in the majority of cases in which I have myself administered the drug, the patients have been sitting. Abstinence from food for a few hours would I think be of advantage, but it does not appear to be essential.

Phenomena of Inhalation.—The first few inhalations give rise to very decided flushing of the face, reminding one strongly of the effects of nitrite of amyl.

The respiratory rate, after the nervous acceleration has subsided, is not appreciably affected ; the regularity of the movements is maintained, but they tend to become shallower. There is no laryngeal spasm or other evidences of irritation, but a faint, regular palatine stertor is developed as narcosis supervenes. The pulse is slightly accelerated, and, at the height of the anæsthesia the tension is much lowered and there is a tendency to irregularity. These points are fairly well brought out in the two tracings, Fig. vii. F. & f, p. 14, which were taken with a Dudgeon's Sphygmograph from the left radial, the patient being seated.

In many instances the irregularity is much more marked, as will be seen for instance on comparing Fig. iv. C & c, p. 12.

The absolute force of the heart-beat is usually much diminished, which point is well brought out in tracings Fig. v. D & d, p. 13.

At about the same time that the alteration in the rhythm of the pulse is noticed, the flushing alluded to gives rise to pallor.

In some few instances in which, by the courtesy of Dr. Greville MacDonald, I have been permitted to administer this drug at the Throat Hospital, for the removal of adenoid growths from the naso-pharynx, we were much struck by the amount of haemorrhage, which was excessive in each case, even for these operations, the blood being of a very bright arterial hue.

In the majority of my cases the stage of excitement has been conspicuous by its absence, even in those instances in which it was most to be expected, e.g., the alcoholic. But this freedom from excitement is not invariable ; in some few instances, without

any obvious cause, transitory spasms of the extremities or rhythmic movements of the limbs, the expressions probably of nervous stimulation, have developed; in other cases again slight mental and muscular excitement has been noticed when, either from accident or design, air has been pretty freely admitted during the inhalation. But in all these cases the excitement has quickly subsided, and has never been sufficiently marked to cause the least trouble. Further, it seems to me just possible that the instability of the drug, and consequent slight differences in the composition of the various samples, may account for some of the irregularities observed in this particular direction.

As a rule the pupils dilate, and the flow of saliva is increased, phenomena which, of course, one would expect to follow the dilatation of the blood-vessels.

From a surgeon's point of view recovery is exceedingly rapid, and though associated in many instances with a feeling of nausea and more or less depression, yet these very quickly pass off. Occasionally the nausea may go on to actual vomiting, but this is apparently less frequently the case than with chloroform.

The completeness and rapidity with which the cardio-vascular system recovers its tone is well exemplified in Fig. vii. p. 14, where f' is a pulse-tracing taken about fifteen minutes after the patient had quite recovered and was on the point of leaving the Hospital.

Dangers.—Many of the ethylic combinations of chlorine, bromine, and iodine possess anæsthetic properties, but there is no doubt that the administration of any of these compounds is attended with more or less risk. There are too, some grounds for the conclusion that the degree of danger is directly proportionate to the atomic weights of these elements; thus for instance, speaking generally, I think it may be assumed that compounds containing iodine are more dangerous than those containing equal molecular weights of bromine, and the latter more so than those containing chlorine. This general assertion holds fairly good as long as the molecular weights are the same, but I am not so sure that it is capable of proof when these weights vary, and *prima facie*, I should be inclined to believe that a substance such as bromine of ethyl (C_2H_5Br), containing approximately 72 per cent. by weight of bromine would be safer than one containing 89 per

cent. of chlorine, as in the case of chloroform. But this of course is a theoretical rather than a practical argument ; deaths have undoubtedly occurred during the administration of this drug, but I venture to doubt whether the death-rate, in proportion to the number of administrations, is higher than that of chloroform. The fatalities recorded appear to have resulted (1) At the commencement of the inhalation from sudden heart-failure ; (2) At a somewhat later period presumably from respiratory paralysis ; or (3) Some hours after the administration from severe gastro-intestinal irritation, such as might result from irritant poisoning.

Practical Conclusions.--The most obvious advantages of this drug appear to be its rapid action and the quick recovery from its effects, with consequent trivial after-effects. If it could be absolutely relied upon, the absence of excitement during the period of induction would be a powerful argument in favour of its use.

Against these advantages we must place its instability and the danger of gastro-intestinal irritation if the inhalation is at all prolonged, while its cardiac-depressant effects, and the experience of recorded deaths, teach us that it is a drug that must be used with caution. Although I would cordially agree with those who assert that bromide of ethyl cannot be looked upon as a satisfactory substitute for either chloroform or ether themselves, yet I am by no means certain that it may not eventually have a place in our list of available anæsthetics. Are we for instance quite sure of the best method of administering the drug ? Or again, looking at its chemical and physical properties, might it not be possible by a judicious admixture of ether to obtain a mixture free from the disadvantages which have been urged against the well-known and popular A.C.E. mixture ; namely, the uncertainty with which the vapours of the several constituents are given off ?

As a substitute for nitrous oxide in dental surgery it has been held, that the nausea and depression which follow its use, alone counterbalance the advantage of slight prolongation of anæsthesia, without taking into consideration its instability and danger.

So far then as our present knowledge goes at any rate, the smaller operations of minor surgery are the only ones in which this drug can be used, and even for this purpose considerable skill and care is required for its successful administration.

